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$$x = \frac{m}{2R} \log \left[\frac{mg - RV^2}{mg - Rv^2} \right].$$

$$\therefore v^2 = \frac{mg}{R} (1 - e^{-(2Rx/m)}) + V^2 e^{-(2Rx/m)}.$$

For the velocity at the surface of the lake, $R=R_1$, $V=0$, $x=h$, $v=v_1$.

$$\therefore v_1^2 = \frac{mg}{R_1} (1 - e^{-(2h/m)}) \dots (5).$$

For velocity at bottom of lake, $x=l$, $V=v_1$, $R=R_2$, $v=v_2$.

$$\therefore v_2^2 = \frac{mg}{R_2} (1 - e^{-(2l/m)}) + v_1^2 e^{-(2l/m)} \dots (6).$$

Following Rankin: $R_1 v^2 = \frac{kAe_1 v^2}{2g}$, $R_2 v^2 = \frac{kAe_2 v^2}{2g}$.

$$\therefore R_1 = \frac{0.51 \pi r^2 g \delta}{2g} = .0000008; \quad R_2 = \frac{0.51 \pi r^2 g}{2g} = .000618.$$

Since $h=500$, $l=40$, we get: from (5), $v_1=162.447$ feet; from (6), $v_2=10.0564$ feet; from (3), $T=5.814$ seconds; from (4), $T_1=1.773$ seconds.

$T+T_1=7.587$ seconds=total time. These results would be slightly changed for different values of R_1 , R_2 .

NUMBER THEORY AND DIOPHANTINE ANALYSIS.

NOTE ON PROBLEM 152.

On referring to the memorandum book from which the problem was taken, I find that p is prime, for which case the theorem would appear to be true. PROPOSER.

155. Proposed by R. D. CARMICHAEL, Anniston, Ala.

If p and q are primes and m and n are any integers, find the cases in which the equation $p^m - q^n = 1$ may be satisfied.

Solution by the PROPOSER.

Some values, found by inspection, are given by Zerr in the MONTHLY for December, 1908. A complete solution may be effected by aid of the following lemma (see *Annals of Mathematics*, Vol. 8, No. 4, p. 15).

If x is a positive integer >1 , $x^t - 1$ has a prime factor not dividing $x^u - 1$ ($u < t$), except in the cases $t=2$, $x=2^v - 1$, $v \geq 2$; $t=6$, $x=2$. Such prime